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DIET AND FORAGING BEHAVIOR OF RING-BILLED GULLS BREEDING AT DOG LAKE, MANITOBA

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ABSTRACT.—Ring-billed Gulls (*Larus delawarensis*) breeding at Dog Lake, Manitoba, were almost exclusively terrestrially based in their foraging efforts. Major food items in late May to early June were earthworms and grain that were obtained by foraging behind farm cultivating implements. Insects increased in importance as the season progressed, particularly for female gulls. Gulls obtained insects by foraging along lakeshore ridges (mayflies) or behind haying implements (grasshoppers). Males obtained birds and mice in the latter part of the season by foraging behind haying implements. Chick diet (from late June to late July) closely paralleled that of adults. *Received 26 May 1986, accepted 19 Dec. 1986.*

Abundant food and the creation of new nesting habitat appear to be the main factors responsible for local population increases of Ring-billed Gulls (*Larus delawarensis*) across North America. Introduction of the alewife (*Alosa pseudoharengus*) into the Great Lakes, widespread intensification of agricultural activities, and the expansion of town and city garbage dumps have had positive effects upon food supplies (Ludwig 1974, Conover 1983); man-made reservoirs have permitted colonization into areas formerly unsuitable for breeding (Conover 1983).

Ring-billed Gull populations in Manitoba are considered to be increasing (Koonz and Rakowski 1985). Here I document foraging areas of a Manitoba population throughout the breeding season, determine food items taken, and relate these findings to other accounts of gull food habits.

MATERIALS AND METHODS

Study area.—The study area (approximately 6362 km^2) around Dog Lake, Manitoba (51°01′N, 98°29′W), contained three major Ring-billed Gull colonies with an estimated total of 3500 breeding pairs. Dominant vegetation in the area includes poplar (*Populus* spp.), spruce (mostly *Picea glauca*), bur oak (*Quercus macrocarpa*), and willow (*Salix* spp.) in the higher areas, and meadow grasses and sedges (*Carex* spp.) in the low areas. Less than half of the available land is used for agricultural crops, with most of the remainder used for grazing cattle. Of the total area in crop production, about 40% is sown to cereal crops, 40% tame hay, and 20% to oil seeds (Manitoba, Dept. Agric., unpubl. data).

Foraging habitat.—To assess the relative importance of different feeding sites to Ring-billed Gulls, I partitioned the foraging area into two halves (north and south). I drove through each half for one full day out to the maximum foraging radius (from previous observations I had determined this to be about 45 km; see also Baird 1976), and included as much lake area as could be observed from the shoreline. Each 2-day cycle (north and

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TABLE 1

NUMBER OF SITE-DAYS[a] RING-BILLED GULLS FORAGED IN VARIOUS HABITATS NEAR DOG LAKE, MANITOBA, AND THE MAXIMUM DAILY NUMBER AT FOUR MAJOR DUMPS, 1983 AND 1984[b]

Habitat	13–16 May	1–15 June	16–30 June	1–15 July	13–16 July
Agricultural land					
Pastures	31	21	4	0	0
Cultivated land[c]	6	42	11	6	1
Hayland[d]	0	3	14	31	12
Marsh, ridge	0	0	5	25	17
Dumps					
Ashern	182	165	50	60	27
Vogar	30	4	40	11	0
Dog Creek	110	33	45	6	5
Narrows	65	67	0	0	58

[a] A site-day is defined as the presence of gulls at a site on a given day without regard to number of gulls.

[b] χ^2 tests comparing frequencies of habitats used for successive time periods: $\chi^2 = 23.6$, df = 1, $P < 0.001$ (late May vs early June); $\chi^2 = 35.1$, df = 2, $P < 0.001$ (early vs late June); $\chi^2 = 16.3$, df = 2, $P < 0.001$ (late June vs early July); $\chi^2 = 1.6$, df = 1, $P > 0.10$ (early July vs late July); $\chi^2 = 217.2$, df = 12, $P < 0.001$ (all months combined). Note that in most cases cell frequencies were combined until <20% of cells had expected values <5. χ^2 statistics for comparison of late May vs early June and early July vs late July periods are corrected for continuity (Siegel 1956).

[c] Discing and seeding implements usually present.

[d] Cutting and bailing implements always present.

south) was repeated every 4–5 days. Upon encountering gulls at a site I recorded habitat type, number of birds, and food types taken. The latter was determined by direct observation.

Diet.—I collected 48 birds in 1984 from flocks in each habitat type, except for beach ridges, as birds foraging there were too wary to permit collection. In addition, 13 gulls that were flying towards the colonies were collected from four compass points (N,N = 3; S,N = 3; E,N = 3; W,N = 4) along the shore of Dog Lake. Collections were made from 4 May to 15 July, but only 2 birds were collected during the last half of June, when heavy rainfall and thunderstorm activity precluded any cultivating or harvesting activities for 9 out of 15 days. Collected birds were sexed by internal examination.

I also collected regurgitations from 13 chicks (in different parts of the colony) that ranged in age from 7 to 20 days. These regurgitations, as well as prey types recovered from the proventriculus and gizzard of collected adults, were preserved in 10% formalin and later identified.

RESULTS

Foraging habitat.—In late May and early June, all gulls were observed foraging on agricultural land, either behind tilling implements (where the principal food was worms and grain), or in pastures, where worms were available (Table 1). As the season progressed (late June onwards), the proportion of gulls on tilled land declined. From late June through the end of the season, marsh and ridge use increased, presumably in response

to emergence of aquatic insects. These insects were usually consumed from the ground, although an occasional gull was observed hawking above the marsh or ridge. Similarly, haying operations began at this time, and gulls fed on prey uncovered or injured by these implements (Table 1).

There was a significant tendency for pastures to be used during and within 3 days of rainfall (85% use during or within 3 days of rainfall vs 10% use at other times; $\chi^2 = 30.3$, df = 1, $P < 0.0001$). On the three occasions when pastures were used without rainfall, flock sizes were small (12–30 birds), and all birds were loafing at the time of observation. In both years, the use of pastures stopped in the latter part of June (Table 1).

On farmland, there were usually either many or no gulls present (mean flock size 107.5 ± 114.0, N = 207). In contrast, a few gulls were almost always observed at each refuse dump (mean flock size 31.3 ± 40.7, N = 50). Peak dump use occurred in May and declined through June and July (Table 1).

Diet.—In late May to early June, earthworms were the dominant prey by volume for those birds on pastures or land under cultivation (Table 2).

The two birds collected in late June returning to the colony had been feeding on insects (95% of the volume was exclusively mayflies). In July, samples taken from returning birds consisted predominantly of Orthopterans (grasshoppers) (Table 2).

From late May to early June, earthworms, insects, and grain were common in the diet of both sexes collected while foraging on pastures or cultivated land (frequencies for males: 67, 83, and 75%, respectively, N = 12; females: 79, 71, and 57%, respectively, N = 14; $\chi^2 = 0.462$, df = 2, $P > 0.05$). Though females averaged a greater volume of earthworms than did males (73 vs 47%), with males consuming larger amounts of grain (46 vs 20%), differences were not significant between sexes (Mann-Whitney *U*-test, $P > 0.05$, both food items tested separately). Insects comprised the remainder of the diet of both sexes.

There was no significant difference in the frequencies of prey taken for the combined July diets ($\chi^2 = 5.582$, df = 2, $P > 0.05$) (Table 3). Overall, males consumed greater volumes of birds and mammals than did females. Insects comprised the bulk of the female diet (Table 3).

Chick regurgitant reflected adult diets throughout the rearing period, which lasted from mid-June to the end of July. In the latter part of June, samples from 3 chicks had volumes of 76% insects and 24% grain. In July, chick regurgitant contained only insects (N = 10 chicks).

DISCUSSION

Foraging habitat.—The distribution of foraging gulls observed in this study indicates a pattern closely tied to agriculture. Despite widespread

TABLE 2

DIGESTIVE TRACT CONTENTS OF RING-BILLED GULLS COLLECTED AT FORAGING SITES OR RETURNING TO THE COLONY IN 1984

Food item	Foraging				Flying back to colony	
	16 May–15 June		1–31 July		1–31 July	
	Frequency (%)[a]	Volume (ml) (%)[b]	Frequency (%)	Volume (ml) (%)	Frequency (%)	Volume (ml) (%)
N	26		22		11	
Earthworms[c]	19 (73)	234.5 (61)	0	0	0	0
Birds (*Passerculus sandwichensis*)	0	0	3 (14)	62.5 (9)	2 (18)	54.8 (21)
Mammals (*Microtus* spp.)	0	0	13 (59)	487.8 (71)	2 (18)	28.3 (11)
Fish[d]	0	0	4 (18)	43.7 (7)	2 (18)	0.9 (1)
Grain	17 (54)	123.0 (32)	1 (5)	5.6 (1)	3 (27)	7.8 (3)
Frogs (*Rana pipiens*)	0	0	3 (14)	13.6 (2)	0	0
Insects	20 (77)	15.4 (4)	17 (77)	64.7 (9)	10 (91)	162.4 (62)
Adult Diptera	1 (5)	2.5 (16)	0	0	1 (10)	21.0 (13)
Orthoptera	0	0	5 (29)	49.2 (76)	7 (70)	133.6 (82)
Larvae	6 (30)	9.7 (63)	0	0	0	0
Other[e]	17 (85)	3.3 (21)	13 (76)	15.5 (24)	8 (80)	7.8 (5)
Debris[f]	6 (23)	11.5 (3)	4 (18)	6.8 (1)	3 (27)	7.8 (3)

[a] Percent of samples. Note that frequencies of insect groups are relative to the total insect sample.
[b] Percent of combined volumes. Volume percentages of insect groups are relative to total insect volume.
[c] Mostly Lumbricidae.
[d] One sample contained Perch (*Perca flavescens*). Four had Fat-head Minnows (*Pimapheles promelas*).
[e] Includes Coleoptera, Homoptera, Odonata, Ephemeroptera, Geophilomorpha, and unidentified insect parts.
[f] Soil particles, gravel.

TABLE 3

FREQUENCY AND VOLUME OF FOOD ITEMS FOR MALE AND FEMALE RING-BILLED GULLS COLLECTED IN JULY 1984

Food items	Foraging				Flying back to colony			
	Male		Female		Male		Female	
	Frequency (%)[a]	Volume (ml) (%)[b]	Frequency (%)	Volume (ml) (%)	Frequency (%)	Volume (ml) (%)	Frequency (%)	Volume (ml) (%)
N	18		4		4		7	
Birds	3 (17)	62.5 (10)	0	0	2 (50)	54.8 (59)	0	0
Mammals	12 (67)	487.3 (78)	1 (25)	0.5 (1)	1 (25)	28.3 (30)	1 (14)	trace
Fish	3 (17)	43.7 (7)	0	0	1 (25)	0.9 (1)	1 (14)	trace
Insects	13 (72)	12.5 (2)	4 (100)	52.2 (97)	3 (75)	5.5 (6)	7 (100)	156.9 (93)
Orthoptera	3 (23)	1.8 (14)	2 (50)	47.4 (91)	2 (67)	5.4 (98)	5 (71)	128.2 (82)
Other[c]	11 (85)	10.7 (86)	2 (50)	4.8 (9)	1 (33)	0.1 (2)	7 (100)	28.7 (18)
Misc. items[d]	4 (22)	24.9 (3)	1 (25)	1.1 (2)	1 (25)	3.8 (4)	4 (57)	11.8 (7)

[a] Percent of samples. Note that frequencies of insect groups are relative to total insect sample.
[b] Percent of combined volumes. Volume percentages of insect groups are relative to total insect volume.
[c] Includes Coleoptera, Homoptera, Odonata, Ephemeroptera, Diptera, and unidentified insect parts.
[d] Includes 3 frogs (*Rana pipiens*), 4 samples of grain, and miscellaneous debris (soil particles, gravel).

obervations of feeding in dumps by a variety of species (Sibly and McCleery 1983a, see Burger and Gochfeld 1983 for other references) few studies have examined the use of dumps during the breeding season versus alternate sources of food (Southern et al. 1976, Sibly and McCleery 1983b). Use of dumps was constant, but minimal in my study area (Table 1), with daily maxima at all major sites totalling less than 5% of the estimated breeding population for any given month. Weseloh et al. (1983) recorded no use of dumps by Ring-billed Gulls from mid-April to mid-July in the Lower Great Lakes, with an increase in dump use in July and August. Blokpoel and Tessier (1986) reviewed five other studies of Ring-billed Gull diets in the Great Lakes and St. Lawrence region during the breeding season, and in only one of seven locations was garbage cited as one of the main dietary constituents. In an Alberta population, Vermeer (1970) recorded a low incidence of refuse in May and June diets and a predominance in July. I did not determine whether a small number of gulls on my study area were specializing on refuse feeding (Hunt 1972).

During periods of rainfall when cultivated fields were too wet for tillage, earthworms became available on pastures throughout the day and were fed upon by gulls (cf. Andersson 1970, Sibly and McCleery 1983b).

Late June represented a transitional period in available foraging habitat. By this time most tilling activities were finished, and farmers began to cut the first crop of hay. Gulls followed the haying implements that flushed and injured small birds, rodents, and insects. Large aquatic insect hatches provided an additional food source along lake shores at this time.

Diet.—The wide variety of food items in gull stomachs in this study confirms what has been found in other populations of Ring-billed Gulls (Vermeer 1970, Baird 1976, Jarvis and Southern 1976, Southern et al. 1976). The population at Dog Lake appears to differ from several others studied to date in that few fish were taken (cf. Jarvis and Southern 1976, Southern et al. 1976, Haymes and Blokpoel 1978). Only traces of fish were found in stomach contents, even though Dog Lake and particularly Lake Manitoba support sizeable populations of fish-eating Common Terns (*Sterna hirundo*), American White Pelicans (*Pelecanus erythrorhynchos*), and Double-crested Cormorants (*Phalacrocorax auritius*) (Koonz and Rakowski 1985).

Similarly, chick regurgitations in this study varied considerably from those reported in the Great Lakes regions where fish are the principal food source (Haymes and Blokpoel 1978, Kirkham and Morris 1979). In Alberta, on the other hand, arthropods were the dominant food type in June, and refuse the chief food in July both for adults and chicks (Vermeer 1970). The Dog Lake Ring-billed Gulls may have become "local specialists" (Fox and Morrow 1981) that forage mainly in agricultural areas.

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